Sample Lab Report Title

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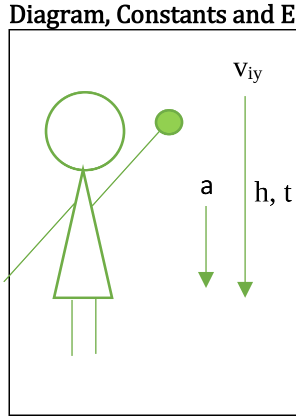
Introduction

The purpose of this lab was to design an experiment using a penny and stopwatch to determine the acceleration of gravity based the curve of best fit from the graphed data. How does increasing the vertical height from the ground that a penny is dropped from affect the amount of time that it takes for the penny to hit the ground from the moment it is released? The amount of time that it takes for a penny to drop to the ground is directly proportional to the square root of the height from which the penny is dropped from, or in other words, $t \propto \sqrt{h}$.

Procedure and Materials

A meter stick was held up against a wall vertically with 0cm as the ground level. Markings of 75 cm, 125 cm, 150 cm, 175 cm, 200 cm and 225 cm were made from the ground using 6 pieces of masking tape on the wall. Ellie held the timer in her dominant hand and a 1993 US penny in the other hand. The penny was held by the ridges with Ellie's fingernails. The flat side of the penny with Lincoln's face on it was both parallel to and 2.5 cm away from the wall. She held the penny so that the bottom edge was directly above the mark for each individual setting. As she released the penny, she hit the start button on the timer with her thumb, so that it started recording. When she saw the penny hit the ground, she hit the stop button again with her thumb. Then she told Abby what her time was and Abby wrote it down. Praneet then picked up the penny and gave it back to Ellie to start again. For the settings 200 cm and 225 cm, Ellie stood on a chair to drop the penny, but this was the only constant that was modified for any of the settings throughout the procedure. 10 trials were performed for each of the 6 settings.

Diagram, Constants and Equations



$m_p = 2.54\ g$ $\quad y_f = 0\ m$

$v_{iy} = 0\ m/s$ $\quad a_T = -9.8\ m/s^2$

$y_i = h$

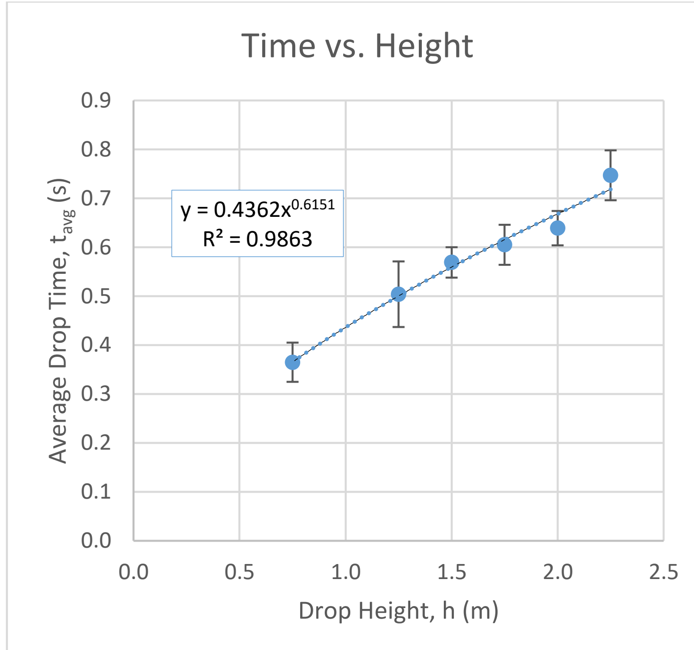
$$y_f = \frac{1}{2}at^2 + v_{iy}t + y_i$$

$$t_T[h] = \sqrt{\frac{-2h}{a_T}}$$

Data Summary

h (m)	t_{avg} (s)	STDEV (s)	%RSD of t_{avg}	t_T (s)	|%err| of t
0.75	0.37	0.04	10.98	0.39	6.70
1.25	0.50	0.07	13.30	0.51	0.21
1.50	0.57	0.03	5.46	0.55	2.84
1.75	0.61	0.04	6.76	0.60	1.24
2.00	0.64	0.04	5.49	0.64	0.02
2.25	0.75	0.05	6.83	0.68	10.24
		Avg	8.14	Avg	3.54

Graph



Analysis

As seen from the data and more clearly from the graph, there is an upward trend to this data. The equation of the graph, which is $t = 0.4362h^{0.6151}$models this upward trend. This equation shows a directly proportional relationship between t and $h^{0.6151}$. The precision of the obtained data is moderate, because of the %RSD value calculated to be 8.14%. Although the data was moderately precise, the data had high accuracy with a %error of only 3.54%. The mathematical fit of the data was high as well, with an r-squared value of 0.986. From the equation of the curve of best fit, a gravitational acceleration of approximately -9.57 can be obtained. The equation has no upper limit, because the higher the penny is dropped from, the longer it will take for the penny to fall to the ground. However, the lower limit of this function is 0, because the "drop height" is always positive since the height at which the penny is dropped from is always above the surface it lands on.

Conclusions

The hypothesis was supported by the data. The equation of the line of best fit shows that the time it takes for the penny to fall is approximately proportional to the square root of the height from which the penny is dropped from. Some sources of error that could have skewed the data was the fact that air resistance was not necessarily negligible. The measurements were approximately the expected values for the theoretical time it would take the penny to fall. Some future extensions would be to make a better system for dropping the penny and recording time, and seeing what would happen with air resistance being non-negligible.